#1 - acid aldehyde

#2 - Acetobacter

#3 - Brettanomyces Hygiene is very important "Leather Bandaid" "Brett"

4/2/2018

Spoilage Organisms and Wine Faults

Molly Kelly, Enology Extension Educator

Most important - feed yeast nutrient

ph levels should be checked before adding SO2

"Sterile culture for yeast strain

Wine aroma faults

- Usually we mean the presence of compounds that are at unacceptable levels for the targeted audience
- Classic:
  - TCA
  - H_2S
  - Acetic acid/ethyl acetate (VA)

Context matters

- Example: levels of aldehydes in most sherries would be a fault (oxidation) in most wines
- Complexity? At low concentration
  - Many compounds associated with "off-aromas" can be acceptable at levels near detection threshold

#4 Brettanomyces 4-eg (4ethylguiacol)

#5 Hydrogen Sulfide

#6 Mercaptan

#7 sulfites

Sources/areas of build up

- Vineyard
- Diluted pools of juice
- Second-hand barrels
- Imported bulk wine
- Areas of winery that are difficult to reach

More classic wine faults

- H_2S and mercaptans
- Volatile acidity
- Geranium taint
- *Brettanomyces*
- TCA (Cork taint)
- Oxidation

Bacteria

- Lactic acid bacteria (LAB)
  - *Oenococcus*
  - *Lactobacillus*
  - *Pediococcus*
- Acetic acid bacteria (AAB)
  - *Acetobacter*
  - *Gluconobacter*

Lactic acid bacteria spoilage

- Typical spoilage times:
  - During "stuck" fermentations
  - Finished wines with low SO_2, residual malic acid or sugar


LAB

- Volatile acidity-metabolism of citric acid and glucose to acetic acid
- Mousiness
- Geranium taint-metabolism of sorbic acid
- Ropiness –production of extracellular polysaccharides

Sorbic acid

- Inhibits many yeast but not LAB
- US limit for wine: 300ppm as potassium sorbate
- Never use sorbate on wines that undergo malolactic fermentation!
- LAB (mostly Oenococcus) will metabolize sorbate $\Longrightarrow$ geranium taint (2-ethoxy-hexa-3,5-diene)
- Detection threshold 100 ppt

LAB

- Some strains are beneficial
- Diacetyl = "buttery" character
- *Oenococcus oeni* is the most common
- When present in high concentrations (>5-7 mg/L) diacetyl is considered a spoilage characteristic
- 1-4 mg/L is considered desirable depending on wine style

LAB

- Aside from potential sensory implications, acetic acid and products of LAB metabolism act as inhibitors to *Saccharomyces*
- Delay onset of fermentation or cause it to stick

Mousey taint

- Aftertaste: not volatile at wine pH;mix with neutral pH of saliva become apparent
  - Mouse urine
  - Rancid nuts
  - Can also smell like acetaldehyde, corn chips (when rub in palms)
- Comes from Brett (rarely) and LAB (usually)

acetic acid Bacteria

AAB

- Oxidize ethanol to acetic acid
- Can grow in barreled or bottled wine
- Can grow using small amounts of oxygen absorbed during clarification and maturation
- Only two genera are recognized: *Acetobacter* and *Gluconobacter*

AAB

- Moldy grapes have a high population of AAB (spoilage after crushing)
- Most serious consequence of spoilage by AAB is acetic acid (volatile acidity)
- Recognition threshold for acetic acid is 0.7 g/L

AAB control

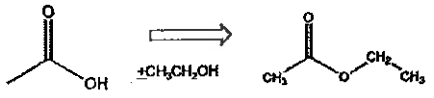
- Low pH (acid)
- Minimize oxygen incorporation
- Maintain cool temperatures (<50 F)
- Free sulfur dioxide levels of 15-30 mg/L
- High VA wines can be blended with unaffected wine or treated with reverse osmosis
- Too high: distillery or make wine vinegar

Acetic acid

- Formed by yeast at low levels during AF
- Produced by LAB during MLF
- Commercial LAB strains generally produce low levels, but spoilage LAB produce more (main source)
- *LAB don't produce ethyl acetate

Acetic acid and ethyl acetate

Sensory threshold much lower for combined vs acetic acid alone
Main source: Acetobacter, wild yeasts



Acetic acid — Ethyl acetate

Acetic acid : detection threshold in wine ~0.5 g/L
In clean young wine 0.1-0.4 g/L
US legal limit: red 1.4 g/L, white 1.2 g/L

Ethyl acetate: detection threshold in wine ~0.08 g/L
In clean young wine 0.02-0.1

Acetic acid and ethyl acetate

- Acetic acid: pungent, vinegar
- Ethyl acetate: nail polish remover, fruity
  - Dominant component of VA
- Around threshold, fruitiness?
- Eventually solvent-like

VA

- 2 components
  - Smells like: vinegar (acetic acid)
  - Fingernail polish (ethyl acetate)
- Comes from
  - Yeast (Brett)
  - Normal by-product of *Saccharomyces* growth
  - LAB during primary fermentation
  - Metabolism of citrate by *O.oeni* (LAB)
  - Acetic acid bacteria

VA post fermentation sources

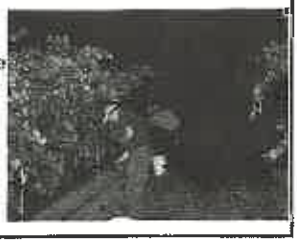
- Headspace in barrels
- Oxidation of wine

VA

- Need to monitor VA: may be increasing but still below sensory threshold
- Reverse osmosis:
  - Expensive
  - Does not significantly remove ethyl acetate
    - Reduce to 0.06-0.07g/100ml-NOT all gone
    - Can return

Bacteria prevention/control

- Grapes
  - Minimize damage to skins
  - Pick when cool
  - Sorting
  - Add SO_2 to picking bins
  - Minimize transport distance
  - Adequate hygiene



Bacteria prevention/control

- Winery equipment
  - Regular cellar hygiene
- Wines
  - Short or no skin contact
  - Adequate SO_2
  - Exclusion of air
  - Filtration
  - Acid addition

More microbial prevention

- SO_2 – 0.5-0.8 molecular
  - Surface yeast and *Acetobacter* pretty resistant
- Avoid cross contamination (thieves)
- Racking and topping introduce air
- Cold storage only delays growth

Spoilage yeasts

- *Kloeckera apiculata*-can produce aromatics such as acetic acid, ethyl acetate and diacetyl
- Most common form of yeast spoilage is due to *Brettanomyces*

Brettanomyces

- Most serious of the spoilage yeasts
- Can spoil wines in barrel/bottled wines as well
- Can be transmitted by fruit flies

- Can grow on cellobiose, a by-product of toasting in barrel production
- Tolerance to sulfur dioxide

Brett

- Smells like:
  - Barnyard
  - Horse (blanket, sweat, saddle)
  - Wet dog
  - Tar
  - Tobacco
  - Creosote
  - Plastic
  - Leather
  - Pharmaceutical (band aid)

Yeast prevention/control

- Grapes
  - Same as for LAB
- Winery equipment
  - Regular cellar hygiene
  - Cooperage
- Wines
  - Adequate SO_2
  - Absence of air/oxygen
  - Filtration

Other visual defects

- Precipitation of tartaric salts (potassium bitartrate)
  - Cold stabilize
- Browning in white wine (oxidation of phenolic compounds)

Aroma defects

- Acetaldehyde
  - Over-ripe bruised apples
  - Sherry
  - Nut-like
- From wine aging (chemical oxidation of ethanol)
- Increased color depth in white wines (golden)
- Brickish tint in red wines

Acetaldehyde

- Cure: SO_2
  - Binds tightly to acetaldehyde
  - Add in increments until free SO_2 be increase
  - All acetaldehyde bound

Reduced sulfur aromas

- Blind tasting of 9,000 wines in 2006: 2% of wines had aroma faults described at "reduced sulfur-like aromas", a.k.a "reduced"
- Typical descriptors: rotten egg, cabbage, rotting vegetable, onion, burnt rubber
- Typical cause: sulfur containing compounds

Hydrogen sulfide

- Aroma: rotten egg
- Ubiquitous to fermentations

One source: yeast metabolism of elemental sulfur

Some factors influencing H_2S production

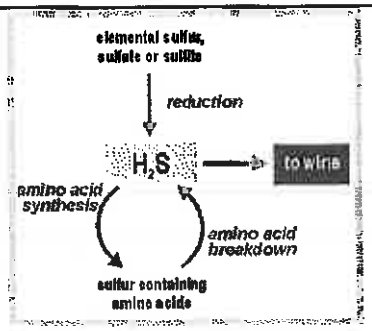
- Low nitrogen: release S as H_2S
- Yeast strain
- High nitrogen
- Elemental sulfur or other S-containing pesticide
- Vitamin deficiency

Sources

- High turbidity
- Must nitrogen deficiencies
- Other nutritional deficiencies
- High fermentation temperatures
- Residue from sulfur sticks/rings in barrels
- Amino acid degradation
- Inadequate aeration during fermentation
- Gross lees contact and extended contact

Why do yeast produce H_2S?

- A byproduct of yeast amino acid/protein synthesis
- Two sulfur containing amino acids are made by yeast
  - Methionine and cysteine



H2S is a natural by-product of yeast metabolism.
Yeasts form H2S by reduction of sulfates, sulfites and elemental sulfur during synthesis of amino acids
Problems: when yeast H2S production exceeds its utilization in forming amino acids- excess to wine
H2S can also be formed by the natural breakdown of amino acids

Hydrogen sulfide

- Can react with other wine components to form mercaptans
- Mercaptans difficult to remove
  - Low threshold of detection
- H_2S is easy

Sulfur dioxide

- Comes from:
  - Added during winemaking (KMS)
  - Yeast (sulfate reduction pathway)
- Smells like burnt match, mothballs
- "sulfitic"

Odors resulting from Sulfur compounds

- Sulfur dioxide (SO_2)
  - Pungent smell like burnt matches
  - Irritation of nose/throat

- Hydrogen sulfide (H_2S)
  - Rotten eggs

- Mercaptan
  - Garlic, onion-like
  - Simple mercaptans can be corrected

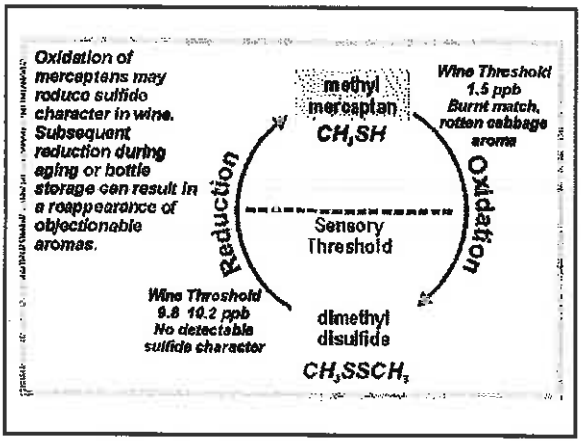
Sulfide detection

- Sulfide detection test using 1% copper sulfate solution
- Will copper remove it?
  - Will remove H_2S and thiols (ethane, methanethiol)
  - Will not remove dimethyl sulfide (DMS) or disulfides
- **Do not aerate** after primary fermentation
  - Oxidize thiols to disulfides

#8 TCA
#9 ~~Earth~~ TCA -
#10 Ethyl acetate -

Assessment after treatment

no change	no change	Not a sulfide problem
no change	Reduction or elimination of smell	Disulfide
Reduction of smell	Elimination of smell	H2S, mercaptan and disulfide
Elimination of smell	Elimination of smell	H2S and /or mercaptan



Mercaptan — White Zinfandel

SO_2 and ascorbic acid

- SO_2: helps break disulfide bonds
  - Disulfides revert back to thiols-react with Cu
- Ascorbic acid: consumes oxygen, prevents oxidation of thiols to disulfides
  - Problem: produces peroxide, depletes SO2

What to do

- Racking/Aerate
- Metal fining
  - $Cu^{2+} + H_2S \longrightarrow 2H^+ CuS$ (insoluble)
  - $Cu^{2+} + 2CH_3SH \longrightarrow Cu(SCH_3)_2$ (insoluble)
- Copper sulfide and copper mercaptide form insoluble black precipitates

Legal limits

- Copper sulfate addition in US: 6ppm
- Final Cu level in wine: 0.5 ppm
- To help preserve mouthfeel, reduce off-aromas, use deactivated yeast in addition to copper (ex: OptiRed)
- Removing copper-use yeast hulls or fresh lees to remove excess

Yeast breeding

- News Headline January 20, 2009
- Wines and Vines

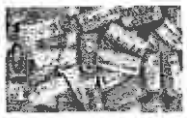
Yeast Technology Eliminates H_2S

UC Davis findings will allow any yeast strain to resist hydrogen sulfide formation

-Linda Bisson

Corked

- Smells like:
  - Musty
  - Moldy
  - Dank cellar
  - Wet newspaper



- Comes from phenol (wood, cork) + chlorine $\xrightarrow{\text{mold}}$ 2,4,6 trichloroanisole
- Can smell one drop of TCA in an olympic size pool
- 3-5% taint rate

Don't USE Chlorine to clean!

Corked

- Chloroanisoles not naturally occurring in wine
- Most often associated with corks
  - Migration of TCA from cork to wine
- Other sources: barrels, beams, pallets, cardboard
  - Contact of wood with chlorine
  - Mold activity

Final thoughts

- Inoculate with known cultures (vs native)
- Provide adequate nutrition
- Monitor critical parameters
  - pH, VA, free SO_2
- Practice good cellar hygiene and sanitation
- Keep containers topped
- Use SO_2 appropriately

#1 - Nice Nose
Pleasant Tart finish

4/2/2018

#2 Traminette - Good Aroma - Tuesday or Thursday

Prevention is always better than a cure

- Control insects
- Screen in-coming corks
- Eliminate halogens
  - Chlorine, iodine
- Sterile filter
- Isolate infected wine
- Smell and taste wine regularly
- Train cellar staff in early detection

References

- Bisson, L., University of California at Davis, University Extension, 2001.
- Margalit, Y., *Winery Technology and Operations*, The Wine Appreciation Guild, San Francisco, 1996.
- Ritchie, G., Fundamentals of Wine Chemistry and Microbiology, Napa Valley College, 2006.
- Wine Tasting and Faults, Society of Wine Educators. http://www.google.com/search?q=wine+tasting+and+faults&rls=p.com.microsoft:en-us:IE-SearchBox&ie=UTF-8&oe=UTF-8&sourceid=ie7&rlz=1I7ADBS_en
- Langstaff, S. and Katchmer J. Wine Sensory defects. Vinquiry Inc.
- Sacks, G., Oak Aromas and Wine Faults, Cornell University
- Sulfides in Wine, ETS Laboratories Technical Bulletin.

Ridgewood Winery - Reading, Pa
Naylor
J P

#3 Slightly Brown Color - "Brut" - Acidic Acid
Indistinct flavor - Bandaid -

#4 - Oak - ARMstrong Valley

#5 - Nice color, Balanced, Smooth, & #1 - Berry - Sulfur, Volatile Sulfur

#6 Nice Tannin,